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IS 8214-4 (1976): Glossary of ships' hydrodynamic terms,
Part 4 Sea keeping [TED 17: Shipbuilding]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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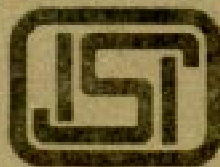


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(Reaffirmed 2002)

Indian Standard
GLOSSARY OF
SHIPS' HYDRODYNAMIC TERMS
PART IV SEA KEEPING

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GLOSSARY OF SHIPS' HYDRODYNAMIC TERMS

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(Continued on page 2)

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IS : 8214 (Part IV) - 1976

(Continued from page 1)

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Indian Standard
GLOSSARY OF
SHIPS' HYDRODYNAMIC TERMS
PART IV SEA KEEPING

0. FOREWORD

0.1 This Indian Standard (Part IV) was adopted by the Indian Standards Institution on 27 October 1976, after the draft finalized by the Shipbuilding Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

0.2 The object of this standard is to specify the technical and scientific terms used in ship geometry, hydrostatic and hydrodynamic terms and to facilitate the exchange of information, particularly at international level, and the ease of understanding as regards to documents relating to naval architecture.

0.3 The terms are represented by symbols which have been arranged in alphabetical order for ease of interpretation.

0.4 No rules are laid down as to whether subscripts are to be shown by capital or lower case letters, although the letters shown in this standard are in the preferred style.

0.5 When required, the suffixes M and S should be introduced to distinguish between quantities referring to model and ship respectively.

0.6 This standard is being issued in six parts. The other parts in the series are :

Part I Basic quantities

Part II Ship geometry

Part III Resistance and propulsion

Part V Manoeuvrability

Part VI Strength and vibration

0.7 While preparing this standard, current work by ISO/TC 8 on 'Terminology of profiles and hydrodynamic terms' and International Towing Tank Conference (ITTC) has also been considered.

1. SCOPE

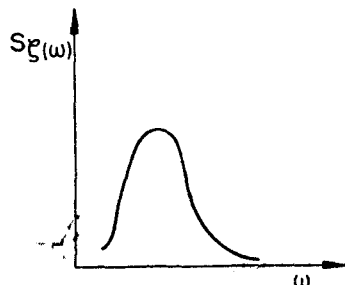
1.1 This standard (Part IV) deals with terms related to sea keeping.

2. TERMINOLOGY

SL No.	SYMBOL	TERM	DEFINITION	SYMBOL OF SI UNIT
2.1	c	Wave velocity or celerity	$\frac{\lambda}{T}$	ms^{-1}
2.2	f	Frequency	$\frac{1}{T}$	s^{-1}
2.3	f_E	Frequency of encounter	$\frac{1}{T_E}$	s^{-1}
2.4	ζ	Instantaneous wave elevation	Instantaneous height of wave peak above mean level	m
2.5	ζ_A	Wave amplitude	Distance of crests or troughs of the wave from the mean level in a sinusoidal sea	m
2.6	$\bar{\zeta}_A$	Apparent wave amplitude	Distance of crests or troughs of the wave from the mean level in a confused sea	m
2.7	$\bar{\zeta}_w$	Apparent wave height	Vertical distance between a successive crest and trough in a confused sea	m
2.8	I_{zz}, I_{xx}, I_{yy}	Real moments of inertia	$I_{zz} = \int (x^2 + y^2) \, dm$ $I_{xx} = \int (y^2 + z^2) \, dm$ $I_{yy} = \int (z^2 + x^2) \, dm$	$\text{m}^2 \text{ kg}$
2.9	I_{yz}, I_{xy}, I_{xz}	Real products of inertia	$I_{yz} = \int y \cdot z \cdot dm$ $I_{xy} = \int x \cdot y \cdot dm$ $I_{xz} = \int x \cdot z \cdot dm$	$\text{m}^2 \text{ kg}$
2.10	k_{zz}, k_{xx}, k_{yy}	Real radii of gyration	$k_{zz}^2 = \frac{I_{zz}}{\int dm}$ $k_{xx}^2 = \frac{I_{xx}}{\int dm}$ $k_{yy}^2 = \frac{I_{yy}}{\int dm}$	m
2.11	m_n	Spectrum moment (where n is an integer)	Moment about y-axis of the surface included by the curve of the spectral density and x-axis	m^{2+n}
2.12	M_{HX}	Horizontal or lateral wave bending moment	Component in horizontal plane of the moment caused by the wave dynamic effects and related ship motion	Nm

Sl No.	SYMBOL	TERM	DEFINITION	SYMBOL OF SI UNIT
2.13	M_s	Moment of ship stability in general	ΔGZ (other moments such as those of capsizing, heeling, etc, will be represented by M_s with additional subscripts as appropriate)	Nm
2.14	M_T	Torsional wave bending moment	Component in transverse plane of moment caused by the wave dynamic effects and related ship motion	Nm
2.15	M_{BV}	Vertical wave bending moment	Component in symmetry plane of moment caused by the wave dynamic effects and related ship motion	Nm
2.16	n_{AW}	Increase in mean rate of revolution in waves	Mean revolutions in rough sea minus mean revolution in calm sea under the same other conditions	s^{-1}
2.17	P_{AW}	Mean power increase in waves	Mean power in rough sea minus mean power in calm sea under the same other conditions	W
2.18	Q_{AW}	Mean torque increase in waves	Mean torque of propeller in rough sea minus mean torque of propeller in calm sea under the same other conditions	Nm
2.19	R_{AW}	Mean resistance increase in waves	Resistance in waves minus the resistance in still water	N
2.20	s	Relative vertical motion of bow with respect to the wave	—	m
2.21	$S_{\zeta(\omega)}$ $S_{\theta(\omega)}$	One dimensional spectral density	Measure of half of mean square of amplitude of the quantity ζ or θ when $d\omega=1$, for a particular frequency ω ; in mathematical terms:	m^2 or s

$$S_{\zeta(\omega)} = \frac{\sum_{\omega}^{\omega + d\omega} \frac{1}{2} \zeta_A^2}{d\omega}$$



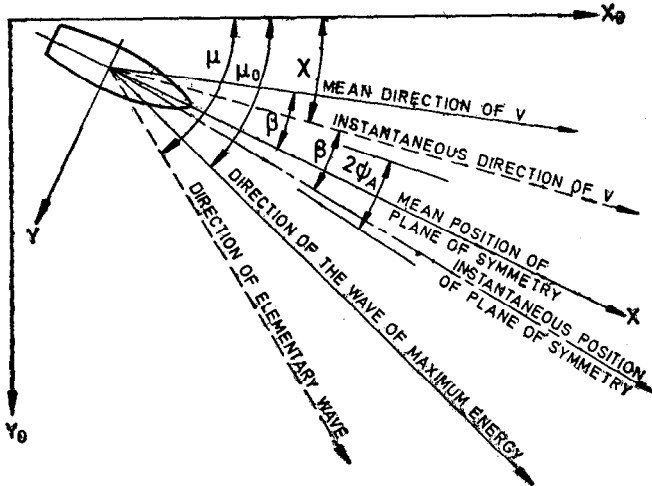
IS : 8214 (Part IV) - 1976

SL No.	SYMBOL	TERM	DEFINITION	SYMBOL OF SI UNIT
2.22	$\frac{S_{\zeta}(\omega, \mu)}{S_{\theta}(\omega, \mu)}$	Two dimensional spectral density	Measure of half of mean square of amplitudes for $d\omega=1$ and $d\mu=1$ of quantity ζ , θ , etc, for a particular frequency ω and direction μ of wave, in mathematical terms: $S_{\zeta}(\omega, \mu) = \frac{\sum_{\omega+d\omega, \mu+d\mu} \frac{1}{2} \zeta_{\lambda}^2}{d\omega \cdot d\mu}$	m^2s or s
2.23	T	Wave period	$\frac{\lambda}{c}$	s
2.24	$T_{\Delta w}$	Mean thrust increase in waves	Mean thrust in rough sea minus mean thrust in calm sea under the same conditions	N
2.25	T_E	Period of encounter	$\frac{\lambda}{c - V \cdot \cos(\mu - \chi)}$	s
2.26	T_z	Natural period (in smooth water) for heaving	Period of free heaving oscillations in calm sea	s
2.27	T_{θ}	Natural period (in smooth water) for pitching	Period of free pitching oscillations in calm sea	s
2.28	T_{ϕ}	Natural period (in smooth water) for rolling	Period of free rolling oscillations in calm sea	s
2.29	$\tilde{T}$	Apparent wave period (according to zero crossings)	The time elapsing between the occurrence of two successive upward crossings of zero	s
2.30	V	Speed of ship	—	$m s^{-1}$
2.31	$Y_{\theta, \zeta}(\omega_E)$	Frequency response function-pitch	$\sqrt{\frac{S_{\theta}(\omega_E)}{S_{\zeta}(\omega_E)}}$	m^{-1}
2.32	$Y_{\phi, \zeta}(\omega_E)$	Frequency response function-roll	$\sqrt{\frac{S_{\phi}(\omega_E)}{S_{\zeta}(\omega_E)}}$	m^{-1}
2.33	$Y_{\psi, \zeta}(\omega_E)$	Frequency response function-yaw	$\sqrt{\frac{S_{\psi}(\omega_E)}{S_{\zeta}(\omega_E)}}$	m^{-1}
2.34	β	Angle of drift or side-slip	The angle to the principal plane of symmetry from the velocity vector of the origin of the body axes relative to the fluid, positive in the positive sense of rotation about the z-axis	—

SL No.	SYMBOL	TERM	DEFINITION	SYMBOL OF SI UNIT
2.35	$\bar{\beta}$	Mean drift angle	Mean angle of the principal plane of symmetry with the velocity vector related to the fluid	—
2.36	δ_R	Rudder angle	Angle of reference plane (generally the plane of symmetry) of the rudder to the plane of neutral position	—
2.37	ε	Phase angle between the motions and the waves	$(2\pi/T_E) \cdot \Delta T_E$, ΔT_E being the time interval between the moments when the ship motions and wave motion have its maximum displacement	—
2.38	ζ_w	Height of a wave	Height of a wave from trough to crest	m
2.39	θ	Pitch angle	Instantaneous angular displacement, about y -axis, of base line from its initial reference position; positive in the positive sense of rotation about the y -axis	—
2.40	θ_A	Pitch amplitude	Maximum angular displacement, about y -axis, of base line from its mean position	—
2.41	$\bar{\theta}$	Mean pitch angle	Mean angular displacement, about y -axis, of base line from its initial reference position	—
2.42	$K, (k)$	Wave number	$\frac{2\pi}{\lambda}$	m^{-1}
2.43	$\tilde{\lambda}$	Apparent wave length (according to zero crossings)	The horizontal distance between two successive upward crossings of zero	m
2.44	μ	Wave direction angle	Angle of elementary wave direction to a fixed direction, such as the local meridian or the ship motion direction	—

IS : 8214 (Part IV) - 1976

SL No.	SYMBOL	TERM	DEFINITION	SYMBOL OF SI UNIT
2.45	μ_0	Predominant wave direction angle	Angle of the direction of the wave of maximum energy to a fixed direction, such as the local meridian or ship motion direction	—



2.46	ϕ	Roll angle	Instantaneous angular displacement, about x -axis, of the principal plane of symmetry from its initial reference position; positive in the positive sense of rotation about x -axis	—
2.47	ϕ_A	Roll amplitude	Maximum angular displacement, about x -axis, of the principal plane of symmetry from its mean position	—
2.48	$\bar{\phi}$	Mean roll angle	Mean angular displacement about x -axis, of the principal plane of symmetry from its initial reference position	—
2.49	ψ	Yaw angle	Instantaneous angular displacement, about z -axis, of the principal plane of symmetry from its initial reference position	—

SL No.	SYMBOL	TERM	DEFINITION	SYMBOL OF SI UNIT
2.50	Ψ_A	Yaw oscillation amplitude	Maximum angular displacement, about z -axis, of the principal plane of symmetry from its mean position	—
2.51	$\bar{\Psi}$	Mean yaw	Mean angular displacement, about z -axis, of principal plane of symmetry from its initial reference position	—
2.52	ω	Circular frequency	$\frac{2\pi}{T}$	s^{-1}
2.53	ω_E	Frequency of encounter (circular)	$\frac{2\pi}{T_E}$	s^{-1}
2.54	ω_z	Natural (circular) frequency for heaving	$\frac{2\pi}{T_z}$	s^{-1}
2.55	ω_θ	Natural (circular) frequency for pitching	$\frac{2\pi}{T_\theta}$	s^{-1}
2.56	ω_ϕ	Natural (circular) frequency for rolling	$\frac{2\pi}{T_\phi}$	s^{-1}
2.57	A_z	Tuning factor for heaving	$\frac{T_z}{T_E}$	—
2.58	A_θ	Tuning factor for pitching	$\frac{T_\theta}{T_E}$	—
2.59	A_ϕ	Tuning factor for rolling	$\frac{T_\phi}{T_E}$	—

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ON

SHIPS' HYDRODYNAMIC TERMS

IS :

8214 (Part I)-1976 Glossary of ships' hydrodynamic terms: Part I Basic quantities

8214 (Part II)-1976 Glossary of ships' hydrodynamic terms: Part II Ship geometry

8214 (Part IV)-1976 Glossary of ships' hydrodynamic terms: Part IV Sea keeping

8214 (Part V)-1976 Glossary of ships' hydrodynamic terms: Part V Manoeuvrability

8214 (Part VI)-1976 Glossary of ships' hydrodynamic terms: Part VI Strength and vibration

8215-1976 Glossary of ships' propellers

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

<i>Quantity</i>	<i>Unit</i>	<i>Symbol</i>	<i>Conversion</i>
Force	newton	N	1 N = 1 kg. 1 m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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